

ENSURING THE FUTURE OF THE TIGER AND OTHER LARGE MAMMALS IN THE SOUTHERN PORTION OF THE NILGIRI BIOSPHERE RESERVE, SOUTHERN INDIA

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The Nilgiri Biosphere Reserve, at the tri-junction of Tamil Nadu, Kerala and Karnataka, constitutes arguably one of the finest conservation landscapes in the global range of the tiger. We surveyed the southern part of this region, as well as the adjoining areas, to assess the status of large mammals both within and outside protected areas. Our field assessments suggest that large mammals are almost exclusively confined to protected areas with the few remaining populations outside under severe threat from habitat degradation and poaching. However, large stretches of contiguous forests still remain. We suggest the extension of the recently notified Mudumalai Tiger Reserve in Tamil Nadu such that connectivity is retained and strengthened with Biligiri Rangaswamy Temple Wildlife Sanctuary of Karnataka to the north-east and with Silent Valley National Park of Kerala to the south. We also provide suggestions on strengthening conservation in this landscape. The involvement of local communities in the establishment of the Siruvani Conservation Reserve in Kerala and Tamil Nadu, and Nilambur Conservation Reserve in Kerala, will bolster the conservation of large mammals in this landscape. With the suggested extension, Mudumalai Tiger Reserve has the potential of becoming arguably the finest habitat for tigers across Asia, given the variations in altitude, topography and climate which produce a diversity of vegetation types and consequently, provide the tiger with an assortment of prey ranging from Nilgiri Tahr in the high altitude montane grasslands to Blackbuck in the low-lying dry deciduous and thorn scrub forests.

Key words: connectivity, corridor, Mudumalai Tiger Reserve, Nilambur Conservation Reserve, protected area, Siruvani Conservation Reserve, wildlife

INTRODUCTION

Tigers *Panthera tigris* are in decline throughout their range and the global population of around 3,500 individuals (Karanth 2001), of which 50% survive in India (Jhala *et al.* 2008), is severely threatened by anthropogenic pressures. Consequently, despite international conservation efforts the range of the tiger has declined by 40% in the last decade (Dinerstein *et al.* 2007; Sanderson *et al.* 2006). India has made a commendable effort towards tiger conservation by establishing as many as 39 tiger reserves and notifying several more for establishment in the near future. However, the mere demarcation of protected areas as tiger reserves has not succeeded in maintaining populations of this endangered felid in these reserves, as evident from the disappearance of tigers from Sariska Tiger Reserve in Rajasthan in 2004 and from Panna Tiger Reserve in Madhya Pradesh in 2009. Again, the low density tiger populations in as many as 16 reserves and the ineffectiveness of management due to insurgency in reserves such as Palamau in Jharkhand, Simlipal in Orissa, Nagarjunasagar in Andhra Pradesh, Indravati in Chattisgarh, Valmiki in Bihar, Dampa in Mizoram and Namdapha in Arunachal Pradesh (Jhala *et al.* 2008) are major concerns for the future of the Tiger in India. It is therefore vital to strengthen

tiger conservation in parts of India where law and order issues do not pose a problem, such that the continued survival of tiger can be ensured in at least some parts of its range. In this paper, we focus on the southern portion of the Nilgiri Biosphere Reserve, where we assess the status of the tiger and other large mammals. We recommend the extension of Mudumalai Tiger Reserve, which was notified in 2007, as well as the creation of Siruvani and Nilambur Conservation Reserves. We underline the conservation measures that need urgent implementation, such that the southern part of the Nilgiri Biosphere Reserve reaches its full potential in maintaining populations of the tiger, as well as an assemblage of sympatric predators and prey species.

STUDY AREA

One of the finest conservation landscapes in possibly the entire range of the tiger lies in the Nilgiri Hills and adjoining areas of southern India (Fig. 1). The intact tiger habitat here is nearly 8,000 sq. km, part of which falls under the Nilgiri Biosphere Reserve. Major protected areas in this region are Pushpagiri, Brahmagiri, Talacauvery, Biligiri Rangaswamy Temple, Cauvery, Sathyamangalam, Aralam and Wayanad Wildlife Sanctuaries, Bandipur, Nagarhole and Mudumalai

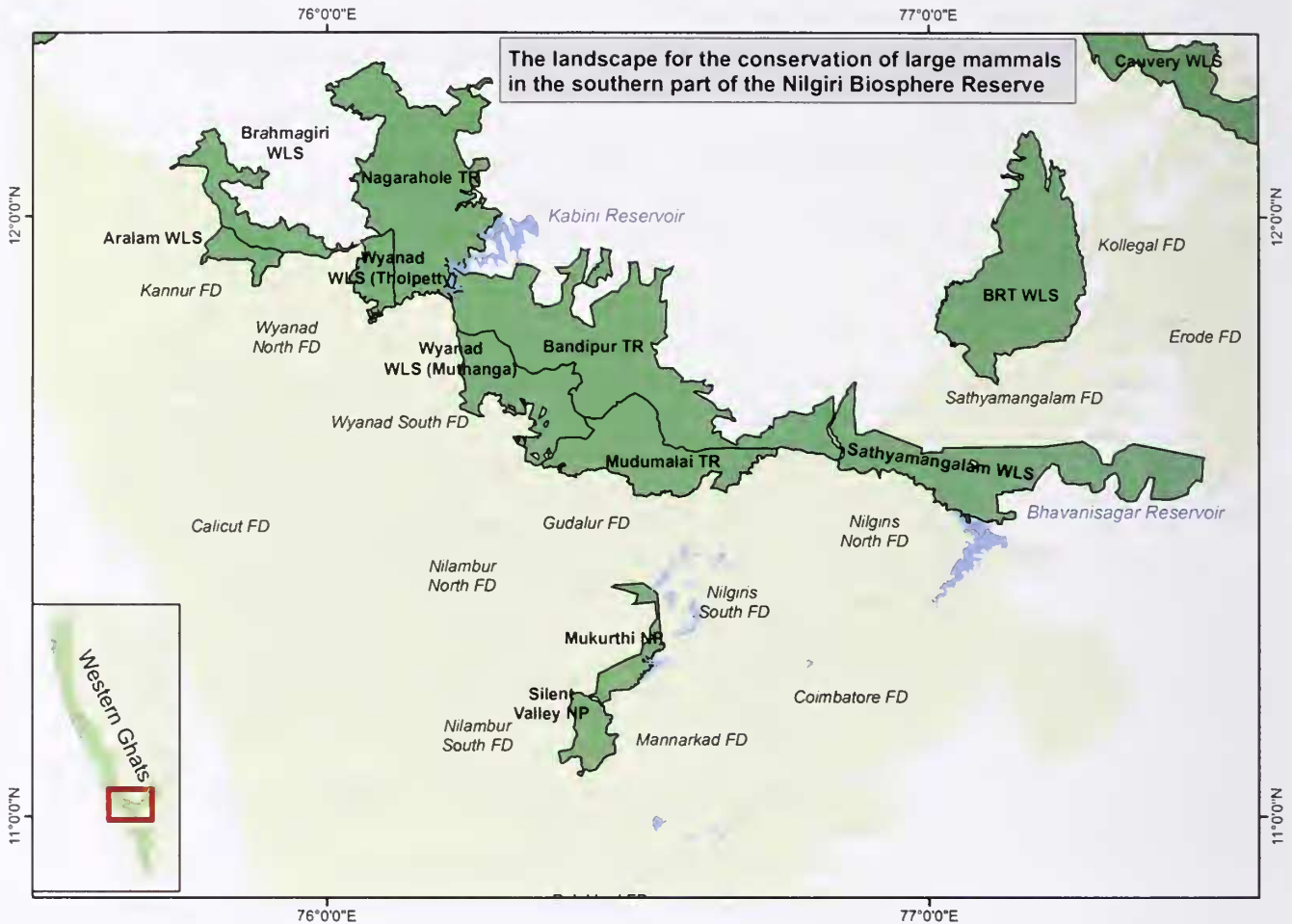


Fig. 1: The landscape for the conservation of large mammals in the southern part of the Nilgiri Biosphere Reserve

Tiger Reserves, and Silent Valley and Mukurthi National Parks. These protected areas are surrounded by reserve forests in the Forest Divisions of Palakkad, Mannarkad, Coimbatore, Nilgiris South, Nilambur South and North, Kozhikode (Thamarassery Range), Wayanad South, Hosur, Dharmapuri and Kollegal. Apart from the Tiger, other charismatic large mammals occurring in this tract are the Leopard *Panthera pardus*, Dhole *Cuon alpinus*, Striped Hyena *Hyaena hyaena*, Sloth Bear *Melursus ursinus*, Asian Elephant *Elephas maximus*, Gaur *Bos gaurus*, Nilgiri Tahr *Nilgiritragus hylocrius*, Sambar *Rusa unicolor*, Blackbuck *Antelope cervicapra*, Four-horned Antelope or Chowsingha *Tetracerus quadricornis*, Lion-tailed Macaque *Macaca silenus* and Nilgiri Langur *Trachypithecus johnii*. In the past, the forests between Biligiri Rangaswamy Temple Wildlife Sanctuary and Mudumalai Tiger Reserve possibly harboured the Cheetah *Acinonyx jubatus*, Wolf *Canis lupus*, Nilgai *Boselaphus tragocamelus* and Chinkara *Gazella bennettii* (Nicholson 1887; Pythian-Adams 1951).

METHODS

We carried out field surveys between November 2007

and July 2009 aimed at understanding habitat quality and documenting habitat use by large mammals in the southern part of the Nilgiri Biosphere Reserve and adjoining areas. We recorded the geographic locations of sightings and signs of large mammals we encountered. We also compiled a description of the dominant vegetation cover and land use along survey routes. The survey data was mapped in a Geographical Information System (GIS) along with remotely-sensed data. A forest cover layer was prepared for the area to examine connectivity and a description was compiled on the location and contiguity of natural habitat across the landscape. On the basis of large mammal occurrence, vegetation-land cover maps, discussions with local communities and Forest Department personnel and our own observations, passages of least resistance for the movement of large mammals were identified.

With regard to the extension of Mudumalai Tiger Reserve, we surveyed Mukurthi National Park, Gudalur and Bitharkadu ranges in Gudalur Forest Division, Singara, Sigur and Nilgiris Eastern Slope ranges in Nilgiris North Forest Division, Bhavanisagar, Sathyamangalam, T.N. Palayam,

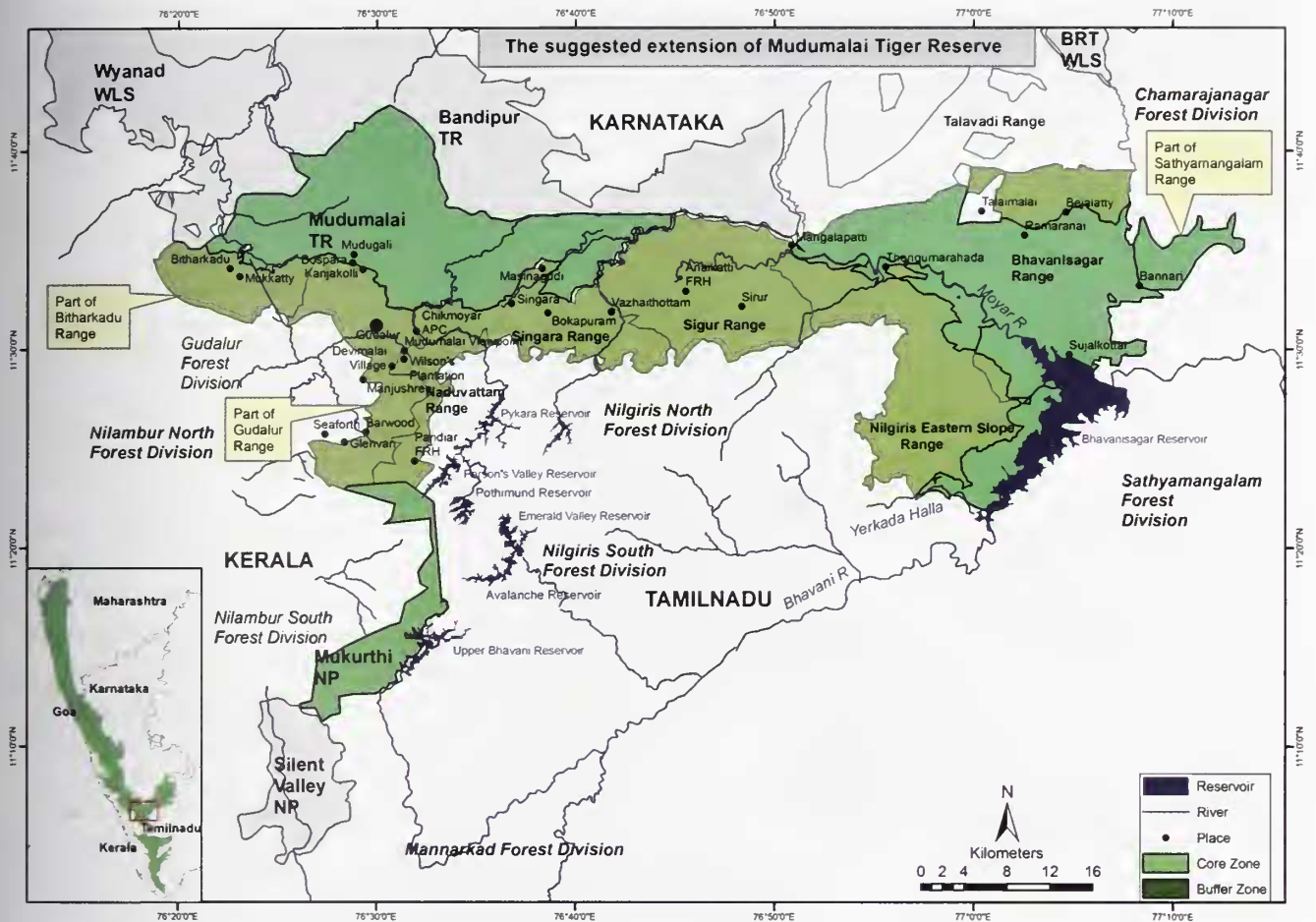


Fig. 2: The suggested extension of Mudumalai Tiger Reserve

Hasanur and Talavadi ranges TR in Sathyamangalam Forest Division in Tamil Nadu, and Biligiri Rangaswamy Temple Wildlife Sanctuary in Karnataka. The total survey effort was 1,400 km by vehicle and 145 km on foot.

With regard to the establishment of Nilambur and Siruvani Conservation Reserves, we surveyed areas to the east and south of Mukurthi and Silent Valley National Parks comprising Palakkad, Mannarkad, Coimbatore, Nilgiris South, Nilambur South and Nilambur North Forest Divisions, Thamarassey range in Kozhikode Forest Division and Meppady range in Wayanad South Forest Division. The total survey effort here was 840 km by vehicle and 24 km on foot.

RESULTS

Mudumalai Tiger Reserve and adjacent areas

The sighting of a Tiger and the presence of its feral buffalo kill near Thengumarahada village together with several sightings of Blackbuck, Chital *Axis axis* and Gaur in the recently established Sathyamangalam Wildlife Sanctuary

indicate the richness of large mammal fauna in this area. Sathyamangalam Wildlife Sanctuary is connected with Mudumalai Wildlife Sanctuary to the east and Biligiri Rangaswamy Temple Wildlife Sanctuary to the north. The flat topography (mean altitude 200 m above msl), and dry deciduous and thorn scrub habitat of Sathyamangalam Wildlife Sanctuary makes it a fairly suitable habitat for Blackbuck. However, proliferation of *Opuntia dillenii* and *Prosopis juliflora*, both exotics from the new world, is gradually beginning to make the habitat too dense for Blackbuck and Chital which are species of open grassland habitats. This area is also well-connected to the montane grassland and *shola* habitats of Mukurthi National Park (average altitude 2,400 m above msl) through Sigur range, Mudumalai Wildlife Sanctuary, and Singara and Naduvattam ranges (Fig. 2). Therefore, these forests on the eastern side of the Western Ghats form a contiguous stretch from Mukurthi National Park to Biligiri Rangaswamy Temple Wildlife Sanctuary. On the west, the connectivity of Mukurthi National Park with Silent Valley National Park is intact.

We obtained direct sightings as well as indirect evidences for the Tiger, Leopard, Dhole, Elephant, Gaur, Wild Pig *Sus scrofa* and Sambar throughout the stretch from Mukurthi National Park to Sathyamangalam Wildlife Sanctuary. In the lower reaches of the eastern slopes, we observed species such as Chital, Chowsingha, Blackbuck, feral buffalo, Southern Plains Grey Langur *Semnopithecus dussumieri* and Bonnet Macaque *Macaca radiata*. This diversity of mammals highlights the unique nature of the habitat with its wide altitudinal range and diverse vegetation types where tigers possibly prey on an assortment of ungulates ranging from the Blackbuck, Chital, Wild Pig, Sambar, Gaur and feral buffalo in the lower elevations to the Nilgiri Tahr in the high altitudes.

However, we identified a number of threats to conservation in this area which include heavy traffic along the Dimbum – Sathyamangalam road and the depletion of the fish resources of the Moyar river, which harbours a population of around 100 mugger or freshwater crocodiles *Crocodylus palustris*, due to the pressure exerted by the Special Task Force camp. There are proposals to build a rail link between Sathyamangalam in Tamil Nadu and Chamarajanagar in Karnataka and a highway between Sathyamangalam and Sirur connecting Ooty/Gudalur, while resorts are proliferating in the Masinagudi area adjoining Mudumalai Tiger Reserve. The proliferation of *Lantana camara* and the lack of regeneration of palatable species for wild ungulates is a serious concern. Nearly 1,600 people live in 30 tiny enclaves in Mudumalai and Nelakottai ranges, and have not been relocated despite their willingness to do so. The growing firewood needs of Gudalur township poses a threat to the Mukurthi-Mudumalai corridor. Burgeoning tourism in the area could be inimical to conservation and there has been a delay in the extension of the Mukurthi National Park (78.46 sq. km) by another 33 sq. km.

Siruvani Hills and adjacent areas

We obtained direct sightings and indirect evidences of the Golden Jackal *Canis aureus*, Elephant, Gaur, Wild Pig, Sambar, Nilgiri Tahr, Nilgiri Langur, Southern Plains Grey Langur, Bonnet Macaque and Indian Giant Squirrel *Ratufa indica*. The moist deciduous forests here afford connectivity to Walayar and Agali ranges in Palakkad and Mannarkad Forest Divisions respectively (Fig. 3). We obtained several indirect signs of Elephant, Gaur and Sambar on a survey of the upper reaches of Agali range to assess connectivity between Siruvani Hills and Silent Valley National Park. We also sighted a tusker, a gaur bull, three Sambar and a Nilgiri Langur in Agali range. However, poaching is reportedly rampant here with many villagers and tribals possessing illegal firearms. We surveyed

Attappady range in Mannarkad Forest Division where the valley is completely under human occupation while the southern hilly areas are forested. No signs of herbivores like Chital and Sambar were found during a drive of 60 km within Karamadai range in Coimbatore Forest Division and up to Pillur reservoir in Mettupalayam range which supplies water to about 50% of the population in Coimbatore city, the other half obtaining water from the Siruvani reservoir. Even though the habitat appears suitable, rampant hunting in the past when the reservoir was under construction and possible poaching at present may be the reason for the near absence of large mammals around the reservoir. Several tribal settlements were observed within Karamadai range each with a sizeable population of dogs. The possibility of tribals using dogs for poaching cannot be ruled out.

We observed a tusker at mid-day on the infrequently used Parali-Coonoor road, which suggests that less disturbed roads may serve as conduits for large mammals. The drive (about 50 km) from Karamadai range to Manjoor in Kundha range, Nilgiris South Forest Division yielded only one indirect evidence each of Sloth Bear, Elephant, Gaur and Sambar indicating that large mammal use of this hilly area is sporadic possibly as a result of speeding vehicles and steep terrain on either side of the road. However, we sighted a group of 19 Gaur at the edge of a *shola* and a tea plantation located between Chamaraj Tea Estate and Kundha Reservoir. The Gaur were unmindful of the people using the road and working in the surrounding tea gardens, which suggests that this bovid, if not hunted and if allowed sufficient habitat, can survive in the proximity of people.

Nilambur Hills and adjacent areas

This zone (Fig. 3) comprises the forest ranges of Karulai in Nilambur South Forest Division, Vazhikadavu, Nilambur and Edavanna in Nilambur North Forest Division, Thamrassery in Kozhikode Forest Division and Meppady in Wayanad South Forest Division. Our survey yielded sightings and indirect evidence of Elephant, Chital, Southern Plains Grey Langur and Indian Giant Squirrel.

The habitat in Karulai range (265 sq. km), which adjoins Mukurthi National Park in the east and is populated by just four *sholanaickan* tribal settlements with a population of c. 600 people, appears to be of good quality. The habitat is devoid of exotic weeds such as *Lantana camara*, *Parthenium hysterophorus* and *Eupatorium odoratum* while the abundance of species such as *Dendrocalamus strictus*, *Bambusa arundinacea*, *Terminalia belerica*, *T. tomentosa*, *Caryea arborea*, *Grewia tiliaefolia* and *Zizyphus xylopyrus* is suitable for large herbivores such as Gaur, Sambar and Chital. However, widespread poaching in the past as also in

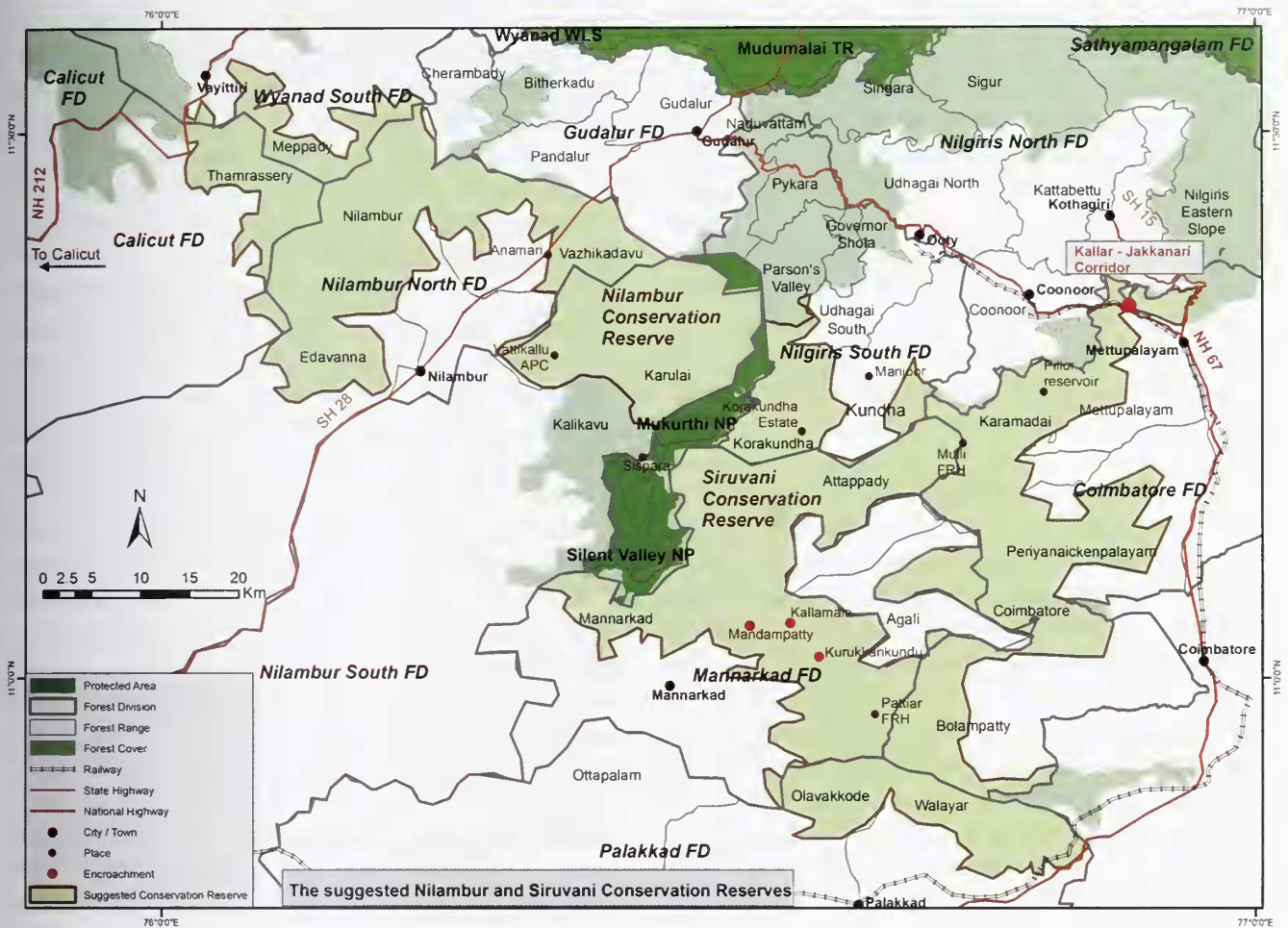


Fig. 3: The suggested Nilambur and Siruvani Conservation Reserves

the present may have resulted in the near elimination of the prey base in Karulai range. Our drive of 38 km and walk of 4 km yielded only a sighting of one elephant herd and a few groups of Southern Plains Grey Langur. We only heard a few Chital alarm calls during a night spent in Vattikallu anti-poaching camp. To the north lies Vazhikadavu range which has a large patch of rainforest habitat with a population of Lion-tailed macaques. Reliable anecdotal evidence suggests that elephants, sambar and wild pig cross the Gudalur-Nilambur road in the area of the rainforest. The landscape north of Nilambur North Forest Division is predominantly tea and reports of the occurrence of species such as the Elephant, Sambar, Wild Pig and Leopard in the tea estates adjacent to the Gudalur-Cherambadi road suggests the possibility that the patches of forests between Bitharkadu range and the road serve as stepping stones for wildlife movement (Bennett 2003). Efforts should be made to identify such stepping stones and protect them. North-west of Thamrassery and Meppady ranges, forest connectivity is broken by the busy Sultan Bathery – Kozhikode National Highway.

Mukurthi and Silent Valley National Parks and Wyanad Wildlife Sanctuary

We also surveyed Mukurthi and Silent Valley National Parks and Wyanad Wildlife Sanctuary to document the status of large mammals within these protected areas and compared the areas with similar habitats outside. Table 1 summarizes the survey effort and large mammal encounter rates within each range of Wyanad Wildlife Sanctuary and Silent Valley – Mukurthi National Parks.

Abundance of *Lantana camara*, *Eupatorium odoratum* and profuse regeneration of *Cassia fistula*, whose leaves are unpalatable to ungulates, were observed on both sides of the survey route in Tholpetty range of Wyanad Wildlife Sanctuary, which is connected to Nagarahole Tiger Reserve in the north and Brahmagiri Wildlife Sanctuary to the west. Drives inside Muthanga (connected to Bandipur TR to the north-east and Benne range of Mudumalai Tiger Reserve in the east), Sultan Bathery (connected to Bandipur Tiger Reserve in the east) and Kurchiad ranges (connected to Begur and Gundre ranges of Bandipur Tiger Reserve) in Wyanad

Wildlife Sanctuary yielded many sightings of large herbivores and many indirect evidences of large carnivores such as the Tiger and Dhole. The highest large mammal encounter rates were in Sultan Bathery range (Table 1). However, the absence of speed-breakers on the six kilometre stretch of the Sultan Bathery – Mysore road which passes through Muthanga range is a recipe for road kills. Since the ban on night traffic through Bandipur Tiger Reserve in mid-2009, vehicles from Kerala line up at the Muthanga gate causing further disturbance to the movement of wildlife. We recommend the shifting of this gate from its present location at the inter-state border to six kilometres within Kerala where the forests begin.

DISCUSSION

Establishment of large, contiguous protected areas and community participation in the protection and management of wildlife are crucial to ensure the long-term survival of wildlife. The aim of setting up conservation reserves is to provide a flexible and effective management system for wildlife conservation without compromising the needs of local communities. Involvement of the local communities would go a long way in promoting and sustaining programs such as regeneration of native species in exotic plantations and strengthening anti-poaching measures. We specify the extension of Mudumalai Tiger Reserve and identify two areas within the southern and south-western Nilgiri Biosphere Reserve where prey and predator recovery should be facilitated with the specific objective of enabling the tigers to reside and breed.

Suggested extension to Mudumalai Tiger Reserve

We suggest the inclusion of Mukurthi National Park, parts of Naduvattam range in Nilgiris South Forest Division, Sigur, Singara, Nilgiris Eastern Slope Ranges in Nilgiris North Forest Division and the newly established Sathyamangalam Wildlife Sanctuary within Mudumalai Tiger Reserve (Fig. 2). Bitharkadu (67 sq. km) and Gudalur (118 sq. km) ranges (Gudalur FD) may not be included within the Tiger Reserve but special management attention in the form of conservation education should be directed at the people of these two ranges, to enlist their support for conservation as poachers from these areas are often reported to operate in the nearby forests. Sigur and Naduvattam ranges are crucial for connecting Mudumalai Wildlife Sanctuary with Mukurthi National Park. There exist historical records of the occurrence of Nilgai *Boselaphus tragocamelus* and Chinkara *Gazella bennettii* in the Sathyamangalam region (Pythian-Adams 1951). Blackbuck is still common in Sathyamangalam Wildlife Sanctuary, Sigur range and the adjacent Moyar range of Bandipur Tiger Reserve. We believe that the Four-horned Antelope, which occurs in the adjacent Sigur range, may also be occurring in Sathyamangalam Wildlife Sanctuary. If Chinkara and Nilgai are reintroduced in this fairly well-protected stretch of habitat, where the factors responsible for their original extirpation may no longer operate, the uniqueness of this landscape will be further enhanced. If this were to be realized, nowhere else in the global range of the Tiger would one find such an assemblage of large mammal prey, ranging from four species of peninsular antelopes, three species of forest deer, a species each of wild cattle, wild pig and mountain ungulate and four primate species.

Table 1: Survey effort and large mammal encounter rates within each range of Wayanad Wildlife Sanctuary and Silent Valley – Mukurthi National Parks

| Species | Tholpetty drive (18 km) | Muthanga drive (28 km) | Sultan Bathery drive (44 km) | Kurchiad drive (51 km) | Silent Valley – Mukurthi walk (50 km) |
|-----------------------------|----------------------------|---------------------------|---------------------------------|---------------------------|---|
| Tiger | 0.05 | 0 | 0.02 | 0.01 | 0.02 |
| Elephant | 0.11 | 0.42 | 0.59 | 0.09 | 0.02 |
| Gaur | 0.16 | 0 | 2.27 | 0.74 | 0.02 |
| Sambar | 0.16 | 1.10 | 0.15 | 0 | 0 |
| Chital | 7.16 | 2.00 | 6.38 | 0.39 | 0 |
| Indian Muntjac | 0 | 0.03 | 0 | 0.03 | 0 |
| Nilgiri Tahr | 0 | 0 | 0 | 0 | 0.02 |
| Wild Pig | 0 | 0 | 0.04 | 0.13 | 0 |
| Southern Plains Grey Langur | 1.05 | 0.28 | 0.68 | 0.07 | 0 |
| Nilgiri Langur | 0 | 0 | 0 | 0 | 0.08 |
| Lion-tailed Macaque | 0 | 0 | 0 | 0 | 0.02 |
| Bonnet Macaque | 0.27 | 0 | 0.27 | 0 | 0 |
| Indian Giant Squirrel | 0 | 0.03 | 0 | 0.05 | 0.06 |

Our sighting of a tiger and its feral buffalo kill occurred near Thengumarahada village, which is situated on the right bank of Moyar river in Nilgiris Eastern Slope Range. The land in the village was originally given to a few families of the *badaga* community on a lease of 100 years. However, they sub-leased their property to outsiders and relocated to cities. After 30 years or so, the Government may have to decide on whether to renew the lease or allow forests and wildlife to take over the village area again. The existence of this village, which is likely to grow into a small town, poses several potential problems to this tiger landscape.

We suggest the regulation of traffic along the Dimbam-Sathyamangalam road by constructing functional speed breakers along the six kilometers between the base of the mountain (Balari Amman temple) and the edge of the forest boundary, the relocation of the Special Task Force camp to control poaching around Kollegal and Coimbatore Forest Divisions and the use of the existing camp by anti-poaching personnel of the Forest Department and trainees of Mettupalayam Forestry College. We strongly urge the scrapping of the proposal to build a railway track between Sathyamangalam and Chamarajanagar and an all weather road between Sathyamangalam and Sirur connecting Ooty/Gudalur as they will forever destroy the last bit of wilderness in the lower Nilgiri Plateau. The problem of lack of regeneration of palatable species such as *Bauhinia racemosa*, *Gmelina arborea*, *Grewia tiliaefolia*, *Lannea coromandelica*, *Terminalia belerica*, *Zizyphus mauritiana* and *Z. xylocarpus* should be addressed by growing thousands of these species in nurseries for several years and planting them along with the onset of the monsoon using *Lantana* thickets as a biofence. Incentive-driven voluntary resettlement of the people living in Mudumalai and Nelakottai ranges should be carried out at the earliest so as to create disturbance-free prey rich areas for the tiger. Connectivity between Mukurthi National Park and Mudumalai forests (Sigur Plateau) can be strengthened by not allowing major tourism development between Gudalur and Naduvattam, by acquiring failed tea estates in this corridor area and by stopping firewood extraction by people from Gudalur. In this context, the possibility of growing firewood species in existing agricultural and waste lands in Gudalur FD needs to be explored so as to meet the growing firewood needs of Gudalur township. It is also important to acquire farms at the junction of Masinagudi, Kargudi and Gudalur ranges, which are not under cultivation, to prevent them from being used as hideouts for poachers. The final notification of the extension of Mukurthi National Park needs to be passed at the earliest. This will include part of Nilgiri Peak, Pothimund and Kundah Reserved Forests.

Establishment of Conservation Reserves

Siruvani Conservation Reserve

The forests of the Siruvani hills (Fig. 3), to the south-east of Mukurthi National Park and to the east of Silent Valley National Park, are important not just to biodiversity conservation, but are also catchments of the Siruvani reservoir, which provides water to hundreds and thousands of people in Coimbatore city. Nilgiri Tahr is reported from a number of locations such as Muthukulam and Vellingirimala within this landscape. Securing these wildlife habitats for conservation would not only ensure connectivity in a west-east direction between Silent Valley National Park and the forests of Coimbatore Forest Division, but also connectivity to extensive forest areas to the north of the Nilgiri Plateau. Around 1,400 sq. km of forested area in Mannarkad, Agali and Attappady ranges in Mannarkad Forest Division, Olavakkode and Walayar ranges in Palakkad Forest Division, parts of Bolampatty, Periyanaickenpalayam, Karamadai and Mettupalayam ranges in Coimbatore Forest Division and Kundha, Korakundha and Udhaigai South ranges in Nilgiris South Forest Division could be included under the suggested Siruvani Conservation Reserve. There are two potential routes for the movement of animals from the Siruvani Hills to the adjoining forest areas.

Corridor 1: The connectivity to the east and north-east of Korakundha towards the Eastern Ghats is through the forested areas of Kundha, Attappady, Karamadai and Mettupalayam ranges. The Kallar-Jakkanari corridor in Mettupalayam range (Fig. 3) seems to be the only transit route for large mammals to move between the forests south of the Mettupalayam-Ooty highway (Coimbatore Forest Division, Mannarkad and Palakkad Forest Divisions) and rail track towards Sirumugai range in Coimbatore Forest Division, Nilgiris Eastern Slopes, Sigur range in Nilgiris North Forest Division and Sathyamangalam Wildlife Sanctuary. The existing connectivity is highly threatened by intense human land use impeding the movement of wildlife such as Gaur and Elephant. Tiger use of this corridor is extremely rare. The heavy traffic on the Mettupalayam-Ooty and Kothagiri highways is another major problem in this corridor. There are plans by the Tamil Nadu Forest Department to acquire some agricultural lands south of the corridor but an 800 m long flyover at the base of the hills for vehicles on both the highways is a must.

Corridor 2: Siruvani Hills to Silent Valley National Park through Agali and Mannarkad ranges of Mannarkad Forest Division is much shorter (less than 10 km) and it passes mostly through the evergreen forests and across grasslands. The habitat connectivity appears intact but there are disturbances in the form of encroachments in the intervening

areas such as Mandampatty and Kurukkankundu settlements which are presently preventing the free movement of large mammals between Siruvani Hills and Silent Valley National Park. This route may be ideal and crucial for the movement of large mammals between Siruvani Hills and Silent Valley National Park but for the encroachments and poachers living within. As a result, large mammal use of this corridor is exceedingly rare. The removal of these encroachments is therefore of vital importance for large mammals to commence using this corridor. On a two kilometre walk to Kurukkankundu hill top through forest and grasslands where bamboo and other species such as silver oak have been planted, we could only see indirect evidence of Elephant and Sambar. Several other encroached areas such as Puliyarai, Kuruvanpadi, Thumbappara and Kallamala in Agali range which presently act as barriers for large mammal movement across this landscape have also been identified during our surveys.

Nilambur Conservation Reserve

Nilambur South and North Forest Divisions occupy the lowlands immediately west of Mukurthi National Park, and to the north-west of Silent Valley National Park. We suggest the demarcation of around 900 sq. km of forested area as the Nilambur Conservation Reserve which includes Karulai range in Nilambur South Forest Division and parts of Vazhikadavu, Nilambur and Edavanna ranges in Nilambur North Forest Division as well as narrow stretches of forests in Meppady and Thamaraserry forest ranges in Wyanad South and Kozhikode Forest Divisions respectively. The major reason for the near absence of large mammals in this tract is primarily due to poaching which needs to be addressed on a priority basis.

CONCLUSION

Wildlife areas in the southern parts of the Nilgiri Biosphere Reserve are linked to the forests to the north (Mudumalai Tiger Reserve) in terms of continuous forest cover; yet a few critical links are extremely narrow and continue to be highly threatened by anthropogenic factors. Establishment of the Siruvani and Nilambur Conservation Reserves on the suggested model will help consolidate the narrow links of forest and revive wildlife populations which are now mainly restricted to Mukurthi and Silent Valley National Parks. This will also facilitate the dispersal of wildlife between protected areas. If well-protected, these two reserves can easily support a minimum of 50 tigers which can add to the existing population of around 250 adult tigers north of the suggested Conservation Reserves (Jhala *et al.* 2008).

Recent developments regarding conservation in this landscape have been very encouraging as in the decision of the Ministry of Environment and Forests to deny clearance to the establishment of the Indian Neutrino Observatory Project in Singara. The proposed site was in the buffer zone of Mudumalai Tiger Reserve which in conjunction with Bandipur and Nagarhole Tiger Reserves forms one of the key tiger landscapes. This conservation victory is the result of efforts by local non-governmental organizations backed by the Tamil Nadu Forest Department. The recent verdict by the Madras High Court to ban construction activities and demolish illegal commercial and private establishments along the Singara Elephant Corridor is also a significant boost for conservation in the area. NGOs such as WWF-India, Nilgiri Wildlife, and Environmental Association and Wildlife Trust of India were responsible for this verdict in favour of wildlife. We hope that the Tamil Nadu Government will be able to establish the corridor as directed by the High Court.

The establishment of Mudumalai Tiger Reserve along the suggested lines will require coordinated efforts of officials from the Tamil Nadu Forest Department, the Government of Tamil Nadu, the National Tiger Conservation Authority, local non-governmental organizations as well as the support of the local people and their elected representatives. An immediate priority is to establish the Mudumalai Foundation, as required by the recently amended Wildlife (Protection) Act, which could provide the legal basis to collect and utilize tourism revenues and other funds allotted for management. Such an independent body can also take care of the welfare of the tribals, local villagers, staff, mahouts and tribal anti-poaching watchers. If correctly established, Mudumalai Tiger Reserve will be peerless in the country for the diversity of its habitat, flora, fauna and ethnic communities. It can easily support a minimum population of 70 adult tigers along with various other endangered species such as the Orange-finned Mahseer *Tor moyarensis*, Mugger *Crocodylus palustris*, King Cobra *Ophiophagus hannah* and Great Hornbill *Buceros bicornis*. The long-term goal for the inter-state tiger landscape where Mudumalai Tiger Reserve is located, should be to have a minimum population of 300 adult tigers along with a thriving population of mega-herbivores, such as the Asian Elephant and Gaur.

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